UNHCR
The UN Refugee Agency

THE GREEN COMPANION GUIDE

Purpose

In line with the UNHCR Climate Action Framework and Operational Strategy for Climate Resilience and Environmental Sustainability (2021), embedding environmental considerations in sectoral interventions plays a crucial role to ameliorate anticipated climate change impacts, improve overall natural resources management and reduce the impact of sectoral responses on the environment. The green compendium can be used in a wide variety of context that UNHCR is operating and should be adapted to each unique context.

The green compendium offers UNHCR personnel and partners practical appraisal tools, case studies and innovative steps to explore the potential options for reducing the environmental impacts in key sectoral areas of settlement planning, shelter, WASH and energy, including clean cooking. The green compendium aims to support the;

1. *mainstreaming of environmental considerations in key sectoral responses;*
2. *reducing of the environmental impact of UNHCR's programming; and*
3. *adapting and utilizing of local solutions to complex environmental questions.*

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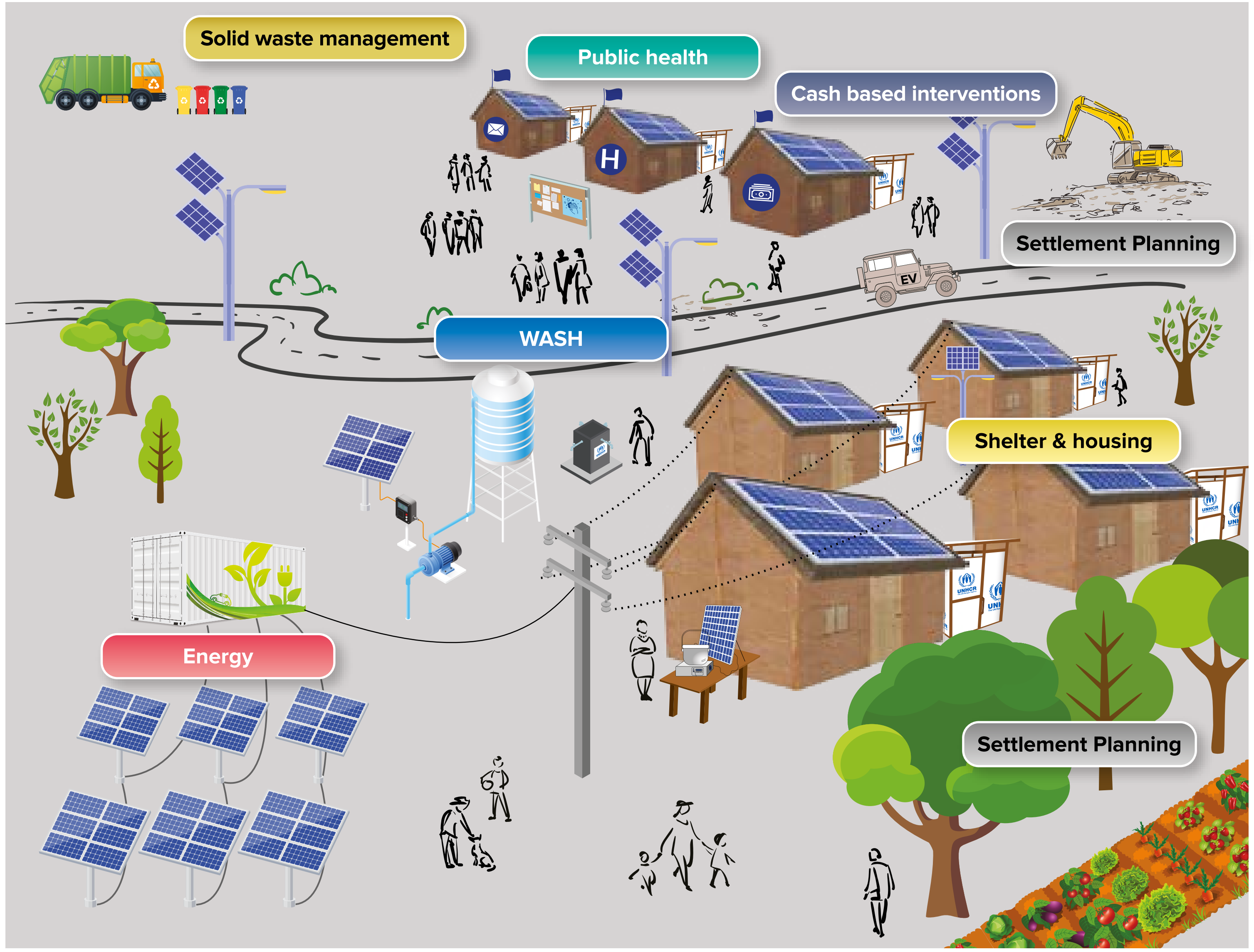

Settlement Planning

Good settlement planning facilitates the resilience and well-being of people, as well as the equitable and efficient delivery of goods and services, and has a positive effect on the environment. Settlement planning includes participation of the people who live there, and promotes self-reliance and enable communities to develop suitable and sustainable solutions themselves. Critically, settlement plans should be adaptable and capable of responding to changes.

The Master Plan Approach

The Master Plan Approach (MPA) to settlement planning provides a framework for the spatial design of humanitarian settlements. It establishes a specific response vision aligned to national, sub-national and local development plans and acknowledges the contributions that humanitarian responses can make toward long-term development efforts.

The Master Plan addressed the key principles of environmental considerations into settlement planning. With a specific reference to Principle 2: Environmental Considerations Drive Design, the MPA advocates for environmental considerations to inform decisions regarding the geographical location of humanitarian settlements, and the definition of site carrying capacity and layout.

To improve our understanding of the conditions, UNHCR uses geospatial and hydrological multisectoral analysis, enhanced ground water monitoring and environmental impact assessments, in both emergencies and longer displacement situations, to be able to better adapt settlements. UNHCR will advocate to include these settlements and camps into national disaster preparedness plans and support mitigation and adaptation measures.

National environmental legislation and regulation	Check host country legislation and regulations, even in the immediate aftermath of a crisis or in the absence of strong governance. All UNHCR activities, e.g. site clearance for new settlements, construction of shelters, borehole drilling, provision of cooking equipment and fuel, should adhere to national regulations with due regard to environmental considerations. Further information can be sought from local authorities. Consider national development plans to ensure that settlement plans are economically, socially and environmentally sustainable.
Site assessment and site carrying capacity	Carry out a risk-based environmental assessment of a proposed settlement site to inform settlement design. Should time or resources for a complete environmental assessment not be available, the Master Plan and Site Assessment Template (MPAT) should be used. During site assessment, consider the natural resource available in and around the site area and their current conditions, minimize the risk of damage to the resource, and wherever possible consider enhancing natural resources available. Assess if the natural resources are of notable local, regional or global importance and/or protected under any international or local conventions and consider the present and future needs in terms of natural resources of displaced populations and host communities (e.g. wood fuel, water resources, land).

Site assessment and site carrying capacity	Calculate water balance (supply vs demand) based on principles of sustainable integrated water resource management at the catchment level taking into consideration demand from both displaced and host populations (refer to WASH) to avoid depletion of water resources. Assess fuel (e.g. firewood) supply, and evaluate the probable rate of consumption compared to regeneration capacity to ensure sustainable supply and mitigate negative environmental impact. It is strongly recommended to pursue alternative access to sustainable energy for cooking and heating (refer to Energy). Wherever possible, during site selection minimize proximity to pristine natural areas and avoid areas of scientific interest. Consider sufficient distance from protected natural reserves (at least 1 day walk). Ensure hazard risk analysis and mapping of flooding, landslides and water bodies in the selected site to avoid building in areas historically affected by natural disasters and prevent secondary displacements.
Site plan design considerations	Wherever possible integrate 'green buffer zones' in settlement design to reduce problems of soil erosion, and help to recharge aquifers. Ideally, buffer zones should be next to rivers and water channels. Contradictory to tradition site planning, integrated approaches understand the dynamic nature of a refugee settlement. It is therefore crucial that design concepts are developed with a comprehensive view, assessing how the masterplan design can help support policies on environmental sustainability, preserve the natural environment and minimize carbon footprint. Set up multi-functional planning teams or partnerships to consult throughout the planning and design phase, to avoid a narrow single-problem approach. Ensure the involvement of the local community in the planning process from the beginning. This will ensure that settlement design can be more coherent, more transparent and more accessible to the community, and design issues will become part of the decision-making process. The overall design should not be over dimensioned, and should consider appropriate densities according the site carrying capacity assessment, which in turn can minimize the environmental footprint of the settlement preparation as a whole. Look beyond the settlement boundary and consider the environmental effect on the territory as a whole including the wider district or administrative region Ensure the planning and design considers carefully all hazard risk analysis and mapping of flooding, natural resources assessments and other surveys suggested in the section above. Consider how the local economic or livelihood system intersect with land use patterns, and whether this system is prospering or under threat, for example is agro-pastoralism suffering in the face of increasing built structures? Combine water management solutions with the need for recreational spaces and communal open spaces in the settlement and propose other sustainable settlement solutions such as community and kitchen gardens. Ensure that the solution is suitable in regard to the land use. Make stormwater visible in the design of public and private open spaces. Create ways to not only buffer water but also to use in times of drought.

Site Clearance/ Preparation	To the maximum extent possible avoid major land transformations. Maintain the existing ground cover (grass, shrubs, trees) of the proposed site, and prioritize sites that have sufficient ground cover as vegetation provides shade, protects from wind and reduces soil erosion and dust. Consider appropriate drainage and soil retention practices. Drainage – use as much as possible the natural drainage of a site. Enhance what already exists. Minimize vegetation clearing and consider re-vegetation and reforestation strategies with native species.
Soil compaction activities	Minimize unnecessary soil compaction (e.g. traffic patterns or material storage), and only compact soils in areas where it is necessary for structural foundations, to reduce surface runoff leading to erosion and soil and water losses or standing water.
Soil Excavation	Minimize the amount of excavated soil for construction purposes. Avoid excavating in areas close to surface or shallow sub-surface water flows to reduce soil erosion and sedimentation of nearby water sources and adverse effects on hydrology, drainage and soil fertility. Besides obvious safety reasons, rebury quickly excavated trenches (~4 days) to avoid accumulation of runoff and therefore becoming vector breeding sites. Excavated soil for shelter construction must be managed or disposed of to avoid excessive runoff or turning into a potential host for vectors. The soil can be re-used locally, or transported to an off-site for other re-use (e.g. construction or landfill cover).
Material use for construction of drainage channels	Drainage channels without a lining (soil) can lead to soil erosion and the formation of stagnant water pools, particularly in areas of high (>5 deg) slopes or completely level ground (<2 deg). In these instances, gravel or concrete channels/pipes can be used to regulate the conveyance of stormwater flow. Installation of underground piping networks (water, wastewater or stormwater collection) can create underground channels that erode native soils. Ensure gravel backfilling of these trenches and compaction.

Shelter & housing

As well as a basic human right, the provision of adequate and appropriate housing should provide privacy, security, protection from the elements, and a sense of home. Shelter should be adapted according to geographical context, climate, cultural practices and habits, local availability of skills within the affected population at large as well as accessibility to adequate construction materials in any given country. Preferred housing solutions must be designed and engineered based on context-specific structural and performance requirements. The shelter should provide a secure and healthy living environment with privacy and dignity and protect from a range of risks, including eviction, exploitation and abuse, overcrowding, poor access to services, and unhygienic living conditions.

A critical environmental consideration in housing programming is the choice and use of materials. Materials choice and use will be determined by the environment, available materials, and at the same time that choice and use will have an environmental impact that needs to be considered.

The development of an appropriate shelter response is a process and not simply the delivery of a product and it is important to ensure the social aspects and needs become also design drivers, alongside technical characteristics and specifications.

Key information is also available in the UNHCR Shelter and Sustainability Guidelines which provides a technical and environmental comparative overview of common shelter typologies found in settlements across UNHCR operations.

Shelter planning and design	In line with an overall environmental assessment conducted as part of settlement planning, conduct a shelter-specific environmental risk assessment. **Shelters in existing settlements:** Incorporate functionality for future upgrades and modular expansion when space allows, facilitate future efforts to utilize existing materials and structures (e.g. from transitional to semi-permanent), avoiding unnecessary consumption of natural resources or demolition. **Shelter in new settlements:** Programming in new settlements involves more activities and materials, compared to programming in existing settlements. ▶ Prioritize local labour as much as possible for construction-related activities to harness indigenous knowledge that can factor in local environmental management practices. ▶ Complement shelter programming with blue – green infrastructure networks and resilient farming and gardens to increase green spaces.
Construction, upgrade, repair and dismantling	Assess, select and use appropriate shelter materials and construction techniques. In particular consider the practices of the host community and the refugees and IDPs. Prefer designs based on context specific structural and performance requirements. Designs should not be over dimensioned and instead optimized to a careful use of construction materials that still guarantee structural stability, load bearing characteristics, etc. The use of traditional construction techniques and materials will ensure that refugees and IDPs are able to maintain and repair the shelter without the need of technical guidance or procurement of spare parts reducing environmental footprint and increasing sustainability. Using similar materials as local buildings leverages existing extraction, production, and supply chain processes which, if previously well-regulated and sustainably procured, can have lower environmental impacts. However, monitoring of the markets is important to ensure these will not be overwhelmed due to increased demands, potentially leading to unsustainable practices such as environmental degradation also linked to increased prices. See also market assessment in CBI. **Dismantling:** The materials and construction method should allow for easy dismantling, transport and reuse by the beneficiary/organization to avoid wasted materials. This is particularly applicable for emergency or transitional shelters due to the likelihood of beneficiary mobility, but also with their lifespan which varies between two to three years depending on local climatic conditions.
Sustainable material sourcing and use	Sourcing locally available materials reduces environmental impacts associated with transportation and distribution. For naturally sourced materials, the provisioning and regeneration capacity of local sources should be considered to avoid over-extraction. Local procurement reduces environmental impacts associated with the supply chain. Sustainable practices or material sourcing should form part of the procurement selection criteria, with contract clauses for selected suppliers. Validation and verification strategies should be in place to ensure compliance.
Vulnerability to hazards minimization	The shelter should be designed with local hazards in mind. Sometimes, multiple hazards may exist in an area. In the case of reconstruction following a natural disaster or in a conflict zone prone to natural disasters, the build-back-better principle should be observed. Engineering solutions can reduce vulnerability to future hazards, reducing the likelihood or need for future interventions.
Maintenance	Regular maintenance of shelter should increase their lifespan, hence it is important to carry out such activities on regular basis. All shelter programmes/interventions should be accompanied by community training and support, for refugees and IDPs to familiarize themselves with and contribute to the construction and maintenance of their homes.
Waste management	Shelter constructions and repair programmes may generate a large amount of waste, some reusable and some not. Ensure that construction waste is included in the shelter construction waste management plan. Consider reuse and recycling as much as possible, and dispose of any waste in an environmentally friendly manner.
Climate considerations	The shelter should be designed for the local climate (temperature, wind and rain or snowfall). Poorly designed shelters with insufficient insulation can lead to unnecessary energy consumption to ensure indoor thermal comfort (e.g. excessive electricity usage for cooling or burning of wood or other biomass for heating). Poor energy practices can also have detrimental effects on human health due to indoor air pollution. An efficient shelter design that considers passive energy savings can improve inhabitant comfort and decrease energy consumption required for heating or cooling.

Ventilation and shading for cooling	Rectangular shelters can be orientated with the long side facing the north-south axis to minimize direct sunlight exposure. The west-facing side has the most intense sunlight and large windows here should be avoided. Trees, foliage, roofs and awnings can be used to provide passive shading. Shelter design can improve inhabitant comfort and decrease energy consumption required for heating or cooling. Raised floors and high ceilings improve ventilation of heat, and openings in the walls and roofs can be used to expel accumulated indoor heat. Doors/windows on opposite sides of rooms/shelters improve natural draft cooling.
Heating efficiency	Rectangular shelters can be orientated with the long side facing the east-west axis to maximize direct sunlight exposure. The west-facing side has the most intense sunlight and large windows improve solar heat gains. The shelter should be as airtight as possible to minimize entry of cold air from outside, particularly around windows and doors. Heaters /stoves should have dedicated exhausts for ventilation to avoid accumulation of indoor air pollution
Insulation	**Hot and dry weather:** Heavyweight materials have high thermal retention capacity and should be considered where there is a high day-night temperature variability. Where there is lower day-night temperature variability, lighter construction materials can be considered, with insulation provided for sleeping spaces. **Cold weather:** Heavyweight materials provide high thermal capacity, keeping heat inside and reducing artificial heating needs. Material-insulated outer walls, roofs and floors provide additional protection from heat loss. Double pane windows also improve thermal performance. **Humid weather:** Shelters should use lightweight materials to improve heat dissipation. Only the roof should be insulated, as to minimize heating from solar radiation. Roofing should include adequate drainage. The structure and fixings should be robust enough to withstand periods of heavy rainfall and rain.
Lighting and cooking	Sufficient access to outdoor light reduces the need for artificial lighting, and thus reduces potential energy consumption and indoor air pollution. Windows should be openable and can include awnings or shutters for protection against direct sunlight or for improved privacy. Consider the proximity of other structures or trees which may limit the availability of natural light. As for cooking, the exhaust of stoves should not be in an enclosed shelter as this exacerbates indoor air pollution. Shelters should include a dedicated cooking area with open ventilation or chimney structure to expel exhaust gases.

Materials	Construction materials can consume non-renewable or low-regenerative capacity natural resources. Ensure that materials selection fits to the local availability and to the environmental context. Material lifecycle, from extraction to disposal, should be considered – the initial design should promote future recycling, reusing or repurposing. Materials selection could be diversified to minimize dependencies from a single source. Fired bricks are energy and water intensive to produce. Locally produced fired bricks often utilize poor quality fuels, such as wood or coal, for powering kilns. Alternatives such as soil or cement-stabilized blocks are potentially less environmentally detrimental and more durable. Wood or bamboo, if sourced from nearby forests, can be extracted unsustainably, beyond regenerative capacities, leading to long-term ecosystem degradation. Endeavors should be made to ensure wood/bamboo is sourced at sustainable rates from forests, or alternatively from managed plantations. Farmed bamboo is often a sustainable option given its high rate of regeneration. Stabilized walls or blocks can be an environmentally preferred building material as they do not require energy for production and there is minimal demand for quarried materials. Required materials (mainly soil) are often available in bulk locally. This material may not be suitable in high-moisture environments or for load bearing walls without additional technical process and additional materials such as cement or lime. Plywood and laminated panels use timber mill by-products, reducing demand on natural resources. Therefore, this material can be a more environmentally friendly option. As plywood and laminated panels can be reused, material wastage is also reduced. The extraction, processing and transportation of metals used in construction for roofing (such as corrugated zinc sheets) can have significant environmental impacts. If possible, sourcing from a sustainable and reputable supplier should be considered such as clay tiles, shingle roof from recycled materials, wood shake roofing or other local materials. Metal construction materials have low thermal comfort and can lead to future increased energy consumption for inhabitant comfort. Proper insulation will reduce energy consumption and promote energy efficiency. Grass for thatching, sticks and mud are usually in abundant supply locally in various African and Asian tropical humanitarian settings and have a high regeneration capacity. This reduces the extraction of non-renewable resources and environmental impacts associated with processing and transportation. However, these materials have limited durability of one to two years so are only usable in certain contexts where sustainable replacement is possible. The use of these materials should thus be used whilst ensuring optimal regeneration to avoid environmental degradation and biodiversity loss. The sand, gravel and limestone required for concrete production can be sourced from poorly regulated quarries or ecologically sensitive areas (e.g. rivers or waterways). Indiscriminate material sourcing can lead to significant erosion. Suppliers should be verified to ensure they engage in sustainable procurement practices. Longer supply chains are justified to prevent further land degradation and damage to ecologically fragile ecosystems. Clay used in bricks or tiles, if irresponsibly extracted, can cause significant land and ecosystem degradation, and waterway contamination. Efforts should be made to ensure that the clay is sourced from environmentally responsible providers.

Dispose / reuse of existing temporary/ emergency shelter materials (e.g. tarps, tents)	Emergency or temporary shelter materials as well as unused building materials can be repurposed or reused to reduce the use of new materials and avoid wastage, e.g. tarps can be used to provide additional weather protection or privacy. Where this is not feasible, a strategy should be in place to ensure that materials are appropriately disposed of, and ideally reused or recycled to minimize their environmental footprint, such as the use of salvage or removed materials to be used for non-structural elements such as the backfilling, partitions, or used as raw materials to construct some tiles or building blocks. UNHCR, IFRC and ICRC are conducting a joint research and development for the eco-design of tarpaulins, focusing on the Ultra-Violet testing and life-cycle analysis of the current tarpaulin. In the next stage, identification of potential alternative eco-friendly materials to replace the polyethylene will take place.
Noise, air and dust management	Dust, noise and air pollution can pose health, discomfort and climatic concerns and especially dust contains particulate matter contributing to global warming and subsequent climate change. Construction activities should be planned to minimize noise and dust exposure to nearby sensitive receptors. Water spraying (if water supply is not a concern) can be used to minimize dust while always avoiding excessive, unnecessary use of water to ensure efficient water use. Vehicles should be well-maintained with idling avoided to minimize vehicular emissions that can contribute towards climate change.

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Case study: Good practices in shelter – Tehama Emergency Shelter Kits (TESK), Yemen

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An enhanced shelter kit using the local available materials was designed in Yemen as the emergency shelter response to locations with colder climates. It covers a surface area of 15 m2 with a volume of 34.5m2. The shelter area can accommodate a family of 4 members according to the minimum sphere standard of 3.5m2 per person. The Tehama Emergency Shelter Kits (TESK) are an innovative type of Shelter Units produced by vulnerable displaced Yemenis themselves. In 2018/2019, UNHCR started building 9,000 TESK within Hudaydah governorate that, in addition, can be upgraded into Transitional Shelters with some minor adjustments. The walls are made by Khazaf sheets that are trimmed and hand-made by Yemeni women from displaced and host communities. Moreover, the mud walls drastically reduce the hot temperatures inside the unit during the summer months. The Transitional Shelter Unit incorporate the materials of TESK to reach a more sustainable upgrade whereas ensuring high levels of cost efficiency by "recycling/adjusting" the materials provided during the emergency phase.

Cash based interventions

Cash-based interventions (CBI) are preferred over in-kind assistance, to deliver assistance and services during humanitarian response in a way that meets affected people in the most flexible manner. UNHCR's Policy on CBI 2022-2026 highlights that cash must be proiritised over in-kind. CBIs are intended to provide refugees, asylum-seekers, returnees, internally displaced and stateless people greater dignity of choice in meeting their needs. Designed and delivered appropriately, CBIs can reduce protection risks, facilitate solutions and improve efficiency and effectiveness in programme delivery. They can also contribute to the local economy and foster positive relations with host communities, as well as have a profound impact on local, regional and national environments. The focus must be on meeting needs by supporting access to environmentally preferable products, through encouraging positive buying behaviors and market enhancements.

Programme design and planning	As part of settlement and shelter planning, the UNHCR's CBI Environmental Checklist can be used.
Market assessment	Consider in the market assessment the potential environmental impacts of items available in local markets, as cash assistance may encourage extraction of local resources (e.g. wood) which can result in negative environmental impacts. This can also lead to increased waste generation.
Sustainable and local procurement	Use of CBI greatly contributes to a more localized response, simplifying the supply chain, reducing emissions from transportation and especially avoiding warehousing while offering great flexibility to beneficiaries for meeting their specific needs in a flexible and customized manner. Examine sustainable local supply chains and incentivize beneficiaries to use them, if a significant increase in demand is likely for some materials (e.g. shelter materials).
Awareness raising and behavioral change	Put in place environmental awareness activities to change behaviors of beneficiaries regarding use of cash and to minimize environmental impacts from their purchasing choices. Consider the durability of products as it is one of the key environmental factors.
Cards, banking solutions	UNHCR works with financial service providers and seeks to maximise the use of digital payment solutions and financial mechanism that refugees and IDPs are familiar with. Environmentally friendly banking options can be used as an additional determinant in the mapping of the financial service providers.

Energy

The need for cooking fuel can have negative protection consequences and increase the risks especially for the most vulnerable. If not implemented well it also has an impact on environmental degradation such as soil erosion, landslides, and desertification. These also threaten safe living conditions and livelihoods for communities. To mitigate these negative impacts and improve protection outcomes, clean fuels and technologies for cooking are the preferred solutions, over the use of unsustainably harvested biomasses such as firewood.

Carbon emissions reduction will be achieved by transition to renewable energy for community facilities including water boreholes, health centers and educational facilities and community learning centers, while providing access to sustainable energy and improve healthcare services and digital connectivity for students. UNHCR, in its catalytic role, will engage with several stakeholders including, but not limited to, public entities and utilities, financial institutions such as development banks, multilateral funds and foundations, donors and their technical cooperation agencies, as well as humanitarian, development, civil society organizations and the private sector to continually optimize energy access solutions for refugees and their hosts.

Access to clean cooking technologies and fuels

Fuel	Wherever possible and availability of fuel supply is sufficient, avoid establishing dependency on locally harvested biomass and give preference to clean cooking options (e.g. LPG, Ethanol, solar-electric, biogas if culturally accepted) or alternative locally produced fuels (pellets, briquettes) over firewood or other traditional solid fuels. Give preference to fuels provided by certified suppliers, authorities, and organizations to promote sustainable sourcing and ensure that procured fuels are responsibly produced, regulated, certified, and safe for use. Consider the distribution of clean fuel for heating and appropriate efficient heaters (electricity, natural gas, LPG, biogas, alcohol/ethanol) in the provision of winterization items, combined with safety training and heat insulation measures to reduce fuel consumption. In case fuel is distributed, plan for adequate and appropriate household space for fuel storage (a dedicated covered space for gas bottles, and dry place for firewood) and provide environmental, health and safety awareness training together with fuel saving cooking techniques. Improper storage of fuels can degrade the fuel and make it unusable and/or dangerous, generating waste of resources leading to decreased combustion efficiency and increased generation of air pollutants. Fuel leaks (e.g. damaged containers, poor sealing, degraded valves) can also cause health and environmental hazards.

Cookstoves	Promote a participatory approach and user-centered design in the selection of the improved cooking stove (e.g., improved biomass cookstove, advance biomass cookstove with gasifier technology, gas cookers, ethanol cookers, solar electric cookers) via focus group discussions, key informant interviews and households survey to assess cultural acceptance and compatibility with existing culinary habits to avoid reverting to unsustainable practices (e.g. three-stone, locally made mud stoves using firewood). Wherever possible, spare parts should be made locally available and operation and maintenance activities of cookstoves and their accessories included in programmes to ensure longer devices' lifespan and hence sustainability. Consider training local technicians to look after the reparations of the stoves to extend the lifespan of the devices.
Energy saving practices	Promote the use of well-fitting lids on cooking pots to reduce cooking time and fuel consumption. Proper preparation of the food before cooking can substantially reduce the cooking time. Wherever possible and culturally accepted consider cooking devices that can save fuel consumption such as pressure cookers in the case of LPG. Consider the use of heat retention baskets to boost fuel savings and keep heat for longer periods.
Indoor air pollution	Consider appropriate design of SHELTER & HOUSING to ensure ventilation and to mitigate indoor air pollution risks coming from indoor cooking activities.
Environmental awareness linked to cooking access	Develop environmental awareness activities that improved the understanding of the implications of cooking habits and fuel use, and encourage practice environmentally sustainable behaviors, such as; ▶ Minimize heat wastage facilitating the reuse of residual cooking heat for e.g., indoor heating. ▶ Adopting techniques for food preparation that reduce fuel needs (e.g. soaking grains and legumes, tenderizing, milling or pre-cutting of cooking ingredients). Include supplies of required items to adopt these techniques in the provision of cooking fuel and technologies. ▶ Apply best practices to manage fires and stoves (e.g. shield the fire, control the air supply, simmer food gently, promptly put out the fire).
Sustainable woodlots management	Promoting and stimulating the use of woodlots for fire wood production is an effective sustainable source of biomass energy and may improve livelihood opportunities for refugee and communities. Always work closely with governments and partners that are specialized in woodlot management for sustainable woodlots programme implementation. For more information see Managing forests in displacement settings (unhcr.org) or the UNHCR REP fund.

Case Study: LPG in Cox's Bazaar, Bangladesh

Rohingya refugee that lives in Nayapara refugee site in Bangladesh receiving a gas stove and cylinder from UNHCR.
© UNHCR/Firas Al-Khateeb

The arrival of more than 740,000 refugees from Myanmar in 2017 put a strain on the local environment in Cox's Bazar, which was already under pressure prior to the influx due to extensive firewood collection in the area. UNHCR has, since worked closely with local authorities and other humanitarian agencies to find a better solution for fuel supply for refugees' cooking needs, to mitigate the impact on the environment and protect and restore it with the help of refugees.

The solution adopted was liquefied petroleum gas (LPG), which is available locally in Bangladesh and was assessed as the best fuel alternative. LPG was piloted in August of 2018 benefitting 6,000 households to start with and rolled out across the camps thereafter. Once fuel was provided, land rehabilitation began with activities involving extensive planting to stabilize and regenerate soil, and rebalancing the impact on the environment. The project is still ongoing in 2021 as continual needs must be met for refugees and host communities and since assessments have proven that the deforestation has dropped by 79% in refugee camps and 53% in host communities.

To improve the sustainability of the LPG programme, UNHCR is looking at the benefits of introducing pressure cookers as technology to reduce fuel consumption in the Rohingya refugee settlements.

Household access to energy

Emergencies	Consider providing portable solar lamps as standard items for in-kind distribution or cash-based assistance to cover energy access needs, where appropriate, to refugee households from the onset of an emergency to avoid the use of open fires, burning sticks, gasoline or kerosene lamps that produce carbon emissions and other pollutants and are harmful for human health.
Portable solar products	Where local markets offer solar portable products (e.g., solar lanterns, solar home systems) that respect minimum international quality standards, consider local procurement to reduce environmental impact of the supply chain.
Hot water provision	Consider the use of solar water heaters instead of using fossil fuels to provide hot water to households.
Electricity access at scale	Where possible, advocate and coordinate with government, development, and private sector actors to connect refugee households to existing national grids. Where national grids exist, advocate for the promotion of renewable energy power plants to reduce the negative environmental footprint and carbon emissions associated with dependency on fossil fuel and diesel generators, as well as related high operating costs on the long term (Jordan – Green Power for Zaatari). Where national grids are distant or absent and connection of the camps are not feasible, promote access to decentralized clean electricity generation for refugee households, such as solar home systems and renewable energy based mini-grids to provide sustainable, clean and at-scale access to lighting and electricity.

Sustainable energy access of communal facilities

Access to sustainable energy	In line with the sustainable energy strategy for 2019- 2025, UNHCR will promote and advance access to sustainable household energy, including the expanded use of renewable energy, to minimize the negative environmental impact in a way that is inclusive of host communities while improving the protection and wellbeing of refugees. Wherever connection to the grid is possible, but unreliable or not covering all the energy needs of the facility, give preference to back-up systems based on renewable energy, such as solar photovoltaic with energy storage capacity. Back-up batteries although initially expensive, provide an environmentally friendly alternative to diesel generators. At end-of-life, consider options to recycle batteries (see e-waste section), ensuring reduction of electronic waste and soil contamination. Where national grids do not exist or connections to them are not a feasible option support hybrid or fully renewable energy mini-grid systems that provide sustainable energy to refugees' community facilities including educational centers, health facilities, water pumping systems and host communities' facilities. Where other options are not available, standalone decentralized electricity generation using renewable energy (e.g. solar with energy storage), rather than standalone diesel generators is recommended.
Operation and maintenance	Operational and maintenance best practices will ensure durability of renewable energy systems. These may include: ▶ Qualified technicians should always be used for the operation and management of renewable energy systems. ▶ Provision of trainings to refugees and IDPs in operation and maintenance of renewable energy systems. ▶ Distribution of renewable energy equipment with locally available spare parts to ensure minimal breakdowns and optimal equipment uptime.
Energy efficiency	Designing and upgrading community facilities to be energy efficient, may include ▶ Optimizing the size of the energy generation system (avoid over-sized or under-sized systems). ▶ Selecting energy efficient appliances (e.g., A+++ fridges, freezers, air-conditioning systems). ▶ Upgrading existing lighting systems with low consumption lighting systems (e.g. LED instead of incandescent lightbulbs, use of occupancy sensors). ▶ Providing adequate and appropriate energy saving best practices training to facility managers and personnel. ▶ IInstalling energy meters to measure and track facilities' consumption.

Case Study: Grid connected solar PV power system in Zaatari Camp, Jordan

© UNHCR

A solar power plant in the size of 33 football fields consisting of 30,000 solar panels is securing the electricity supply of a refugee camp in the Jordan desert. This not only gives the Syrian families a feeling of normality, but also creates busy city life. In November 2017, living conditions in Zaatari, one of the world's largest refugee camps, improved significantly. A photovoltaic system was put into operation, the largest one in a refugee camp run by UNHCR, and it is the second such system ever used in a UNHCR camp. Electricity that is produced when the sun is shining but not used in the camp is fed into the Jordanian grid. Because Zaatari now needs less electricity from fossil fuels, Jordan's carbon emissions are reduced by 15,000 tons per year.

WASH

Refugees can live in harsh environments that make access to WASH services complex. Untreated water and lack of proper sanitation and hygiene put refugee health, protection, education and livelihoods at risk. Climate change poses serious risk to the delivery of water and sanitation services to refugees and host communities. Climate change impacts water resources and water requirements and drought and heatwaves, storms and flooding make the delivery of services more complex.

Energy for water extraction, treatment and distribution

Renewable energy sources	Solar, hybrid or other renewable energy sources should be prioritized over carbon-based fuel generators to eliminate as much as possible fossil fuel consumption in the operation and maintenance of water pumping, treatment and distribution. Use of gravity fed systems rather than motorized ones also have positive environmental outcomes.

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Water sources

Groundwater	The extraction of groundwater should be coupled with continuous groundwater monitoring to ensure extraction and recharge is done within the capacity of the aquifer to recharge. Failing to do so may lead to irreversible consequences on water levels, the environment and the sustainability of the settlement and as a consequence the habitability. Borehole operations should respect the following requirements to be environmentally sustainable: ▶ Site boreholes are to be based on hydrogeological criteria, transportation costs and the energy required for distance pumping or to allow for piped network installations. ▶ Ensure the optimization of pumping (specific number of hours per day) to reduce power consumption. ▶ Employ various energy saving equipment, such as variable frequency drive (VFD) pumps. ▶ Wellheads should be protected from damage and contamination so that the groundwater is protected from external pollutants (including agricultural runoff water, sewage, and other wastewater sources). Regular maintenance and ensure that damaged, broken and worn out parts are replaced, will increase efficiency. ▶ Minimize the number of boreholes drilled, which could provide entry points for contaminants to the aquifer, and prevent contamination of water sources. ▶ Ensure quality of borehole construction to optimize the lifecycle of the borehole and to minimize operation and maintenance costs. ▶ See: F-300/2017a UNHCR Well Construction Documentation I UNHCR WASH as well as F-302/2015a Well Cleaning and Chlorination Log Sheet (UNHCR, 2015) I UNHCR WASH. See Case Study: Rapid Groundwater Potential Mapping for Sustainable Water Supply in Uganda.
Managed Aquifer Recharge (MAR)	MAR is the intentional recharge of an aquifer under controlled conditions for water recovery and aims to mitigate the impacts of groundwater extraction. MAR recharges aquifers through injection bores or structures such as infiltration trenches or ponds. This planned additional volume of recharged water can reduce pressure on groundwater resources, since it diverts and collects direct rain runoff to inaccessible water sources and increases groundwater recharge. Care needs to be taken constructing and managing MAR infrastructure to minimize contamination risks.
Springs	As natural groundwater discharge points, springs can have a large range of flow rates and water quality. The higher the seasonal fluctuations in flow rate and water quality there are, the more vulnerable springs are to pollution. Particular attention should be given to the spring catchment to mitigate additional potential contamination.

Surface water	Surface water sources, whether stationary or flowing (rivers, lakes, etc.), are not safe for drinking without treatment. As all surface water sources are vulnerable to pollution and pathogen contamination, surface water quality should be regularly tested and monitored, with treatment strategies and processes in place at all times. Treatment protocols should be adapted in accordance with results from regular water quality monitoring. For water treatment, if energy is needed, solar powered systems are recommended over diesel generators to minimize carbon emissions and potential further contamination of the water source. Avoid discharging of treatment wastewater into surface water bodies as this can lead to pollution and health-related risks.
Infrastructure close to sensitive ecosystems	Ecosystems can be adversely affected by the construction of and operation of water supply facilities, with largest impacts in sensitive areas. Where possible, construction in sensitive areas should be avoided or expert local advice should be sought to minimize potential impacts of material extraction and construction hazards, if otherwise not possible. Operational impact mitigation should be a paramount concern in sensitive areas. Close coordination with local relevant authorities is also critical.
Rainwater harvesting	Rainwater harvesting can replace or augment other water sources for both domestic and institutional or community purposes. The technologies associated with rainwater harvesting do not require energy for collection or storage. It can be explored in some contexts, but may have limitations related to water quantity produced and water quality. Testing and treatment is recommended.

Water treatment & distribution networks

Water wastage / leakage minimization	Leakage at extraction points, in water distribution systems and at communal collection points wastes water causes localized erosion, increases the risks of source contamination and can create water hazards, especially for young children. It also increases the potential for vectors to breed. Leak mitigation measures include: ▶ the choice of durable pipe materials and appropriate bedding for buried pipes to reduce the likelihood of pipe rupturesleak tests and acoustic monitoring before backfilling or covering subsurface installations, ▶ increased asset security by restricting access to water system components which could be illegally tapped by installing fencing and burying networks, ▶ consideration for intermittent pressurization to prevent continuous leaks and wastage of water resources. Visual monitoring of particularly at taps, valves, connections, water tankers or pressure testing of water assets should be used to identify potential leakage points. In addition to Real Time Monitoring (RTM) devices can be used for flow analyses and leakage identification.
Water trucking	Water trucking is used where there is no water available from other sources and is a temporary measure. Water trucking has continuously high costs and has an enormous environmental burden given the high fuel consumption, as well as safety risks when travelling in congested camps, air pollution if running on dusty roads, and difficulty in monitoring strict water quality if a large fleet is used. Identifying alternative water sources and developing a strategy to quickly phase out water trucking should be pursued with high priority. Water for trucking should be extracted from certified sources only, so considerations for groundwater above should be referred to. In case these sources do not meet the minimum standards mentioned above, UNHCR/partners should undertake maintenance or upgrading of the same. See: G-300 Briefing Note on Water Trucking in Refugee Settings (UNHCR 2018).pdf.

Water usage

Low water consumption options	Systems for regulating water usage minimize the likelihood of water wastage. Local community structures can enforce water usage regulations. Identify social influencers who can support advocacy initiatives to prevent wastage and integrate water efficiency measures in programme design. Poorly designed or aging infrastructure can also increase waste.

Wastewater collection, treatment and disposal

Wastewater consists of:

- blackwater from toilets, which is faecally contaminated; and
- greywater from bathing areas, laundries, kitchens and other use points, which is not generally faecally contaminated.

Grey and black- water separation	Where appropriate, black and greywater should be separated at the source and managed separately.
Blackwater containment on site	A site-level risk assessment of potential contamination from toilets (household, communal or institutional) of any nearby surface or ground water source should be carried out.
Faecal sludge treatment and reuse	Faecal sludge from toilets can be transformed into a fertilizer, soil conditioner, briquettes or biogas but handling fecal matter need to be undertaken safely. Treated sludge can contribute to soil restoration and livelihoods (e.g. through tree planting, growing bamboo, and high value non-consumable crops such as maize where regulations allow), as well as biogas production.
Wastewater discharge quality monitoring	Desludging trucks should discharge wastewater at treatment facility or appropriate sites. Where relevant, wastewater discharge testing should be performed to ensure that the contaminant loading from wastewater systems complies with the relevant effluent standards or assimilative capacity of receiving water bodies.

Case Study – Rapid Groundwater Potential Mapping for Sustainable Water Supply in Uganda

To meet the demand of drinking water in refugee emergency situations, it is key to quickly assess possible water sources and plan for sustainable water supply options to be able to rapidly transition away from acute, and costly, emergency responses, such as water trucking. The refugee influx from South Sudan into Uganda, ignited the development of a spatial tool to rapidly assess borehole yield range probabilities for the identification of areas where borehole drilling is likely to be successful.

The Rapid Groundwater Potential Maps (RGWPM), developed in close collaboration with the Geneva Technical Hub, guide the planning of geophysical investigations and are a practical tool for humanitarian actors and decision makers to strategically plan and implement which water supply option is most adapted where. The use of RGWPM in Uganda significantly increased the average yield of the sited boreholes when compared to the boreholes sited without RGWPM. These boreholes triggered the transition from emergency water supply (water trucking and hand pumps) towards sustainable solar-powered water systems.

The mapping has been since extended to 13 refugee operations, with an objective to establish a scalable methodology usable in any refugee context around the world to optimize well siting, increase yields and enable sustainable water provision. The methodology is available for replication by any hydrogeologist.

Solid waste management

Solid waste, generated by households, institutions and commercial properties, or community facilities such as markets, can directly pollute local environments and surface or groundwater sources. It can also indirectly affect ecosystems by blocking natural drainage channels. Poor management or mismanagement of solid waste can also have a direct impact on air and water quality. Any work on solid waste management, should be coordinated with local authorities, field, the wash and health sectors. See UNHCR Solid waste management action plan template.

Waste generation and type estimation	Understanding the different waste stream types and quantities/volumes can help identifying opportunities for reduction, recycling or reuse of certain types of waste, in conjunction with assessment of the local market potential.
Measures or incentives to promote a reduction of waste generation	Strategies to minimize waste generation should be inherent to any solid waste management activities. Many waste streams are preventable through alternative practices or behaviors, or by simply re-using or re-purposing goods/materials. Behavioral change of beneficiaries can be encouraged through awareness campaigns. Appropriate incentives promulgated by local authorities, such as the use of reusable textile bags as opposed to plastic bags, could also be leveraged.
Non-reusable packaging reduction	Humanitarian emergency responses often significantly strain solid waste management capabilities as single use packaging is often employed. Avoidance or reduction of non-reusable packaging reduces the amount of waste generated.
Solid waste collection	Collection of waste can take place at household and community levels. Care should be taken to ensure waste is adequately contained at collection points, and that further collection is scheduled to eliminate waste spilling at collection points.
Measures or incentives to promote composting and waste to energy (biogas/ briquettes)	A majority of household municipal solid waste is organic. Source segregation of organic waste should be encouraged based on cultural acceptance as well as sensitization on the potential use of organic waste for production of compost for small scale individual or community gardens. Kitchen composting and appropriate wet pits (anaerobic) can reduce volume of organic waste collected in communal solid waste collection if practiced responsibly and with capacity building support. Organic waste typically undergoes anaerobic digestion, generating greenhouse gases (methane) and leachate (concentrated polluted wastewater). Promoting composting recovers valuable nutrients, improves soil fertility and also decreases the amount of solid waste. At the same time, cultural acceptance and consistent organic waste generation rates are the greatest determinants for feasibility. Organic solid wastes, if properly collected, disposed and treated can be transformed into a source of energy (biogas, briquette). Assess the volume of organic solid waste that can be collected and define 'waste-to-fuel' strategies.
Measures or incentives to promote recycling	The reuse and recycling of materials should be promoted as much as possible. Waste collectors can facilitate recovery of recyclable waste streams (e.g. paper, plastics, metals) which also decreases the amount of solid waste to be managed by the formal system. Such collection can also present a cost recovery or livelihoods opportunity.

Waste disposal	Solid waste should not be dumped near communities or ecologically sensitive locations. Disposal of collected waste should always be coordinated with the relevant local authorities. If possible, established locations with landfill management capabilities should be used. Unmanaged dump sites can pose health and environmental risks, through the effects of leachate contamination of surrounding soils and groundwater resources. Leachate can be controlled with leachate collection (piping and trenches) and storage systems. Optimized waste transportation (route optimization, transfer station installation, etc.) should be performed to minimize the environment footprint associated with fuel burned for transportation in the form of the release of emissions into the atmosphere. Burning of waste should be avoided at all costs as this causes environmental pollution such as the release of highly toxic furans and dioxins from burnt plastic waste into the atmosphere which is detrimental to human health.
E-waste	Consider management of end-of-life products to **minimize the volume of waste generation from electric and electronic equipment disposal.** Consider procuring products that have high reparability characteristic and develop associated vocational trainings for Persons of Concern involved in recycling activities. After end-of-life, identify e-waste management solutions, such as: ▶ Collection ▶ Repurposing ▶ Recycling ▶ Proper disposal through accredited entities ▶ Consider take-back and leasing options with suppliers to be investigated during procurement processes (Extended Producer Responsibility) Electronic Waste Management for Off-grid Solar Solutions in Displacement Settings

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Public health

Climate change is impacting health in many ways and leading to death and illness from increasingly frequent extreme weather events, such as heatwaves, storms and floods, as well as increases in water- and vector-borne diseases, and mental health issues.

At the same time, the health sector itself can have an environmental impact and mitigation in waste management, use of energy and transport can positively contribute to reducing the negative environmental impacts.

Safe segregation of health care waste	▶ Promote practices that reduce the volume of waste generated and ensure proposer waste segregation; ▶ Develop strategies and systems to incrementally improve waste segregation, destruction and disposal practices with the ultimate aim of meeting national standards if existing and international standards; ▶ Where feasible, favor the safe and environmentally sound treatment of hazardous health care waste (e,g, by autoclaving, microwaving, steam treatment integrated with internal mixing, and chemical treatment) over medical waste incineration; ▶ Build a comprehensive system, addressing responsibilities, resource allocation, handling and disposal; ▶ Raise awareness of the risks related to health-care waste, and of safe practices; ▶ Select safe and environmentally-friendly management options, to protect people from hazards when collecting, handling, storing, transporting, treating or disposing of waste. Health-care waste (who.int) ▶ Refer to WHO Guidance: Safe management of wastes from health-care activities, 2nd ed. (who.int)
Final disposal of medical waste	▶ For medicines and supplies, advocate with governments and partners for safe disposal taking into account environmental considerations. Many countries either do not have appropriate regulations, or do not enforce them. Health-care waste (who.int) ▶ Where no national policy or guidance exits, refer to WHO Guidance: Safe management of wastes from health-care activities, 2nd ed. (who.int)
Medicine management	▶ Ensure effective medicine management and supply to reduce expiration of medical products and appropriate treatment of expired medecines in accordance with national protocols and WHO – Guidelines for the safe disposal of expired drugs. ▶ Favor maritime over air transport. Emergency orders should be minimized through good medicines management and effective supply chain management by UNHCR and partners to avoid stock outs. ▶ Medicines and other medical consumables that may expire or be damaged during deployment must be destroyed in accordance with national protocols and WHO recommendations. ▶ Favor procurement of medications in bulk containers rather than blister packs to reduce transport volume and packaging waste.

Energy access of health care facilities	Wherever possible connect the health care facility to the national electrical grid to ensure power supply and 24/7 emergency medical service. Where the connection to national grids is not feasible or the energy provision is unreliable and required to guarantee quality of health care, consider the installation and use of renewable energy (solar and energy storage) instead of diesel generators to provide back-up power provision so as to minimize GHG emissions.

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